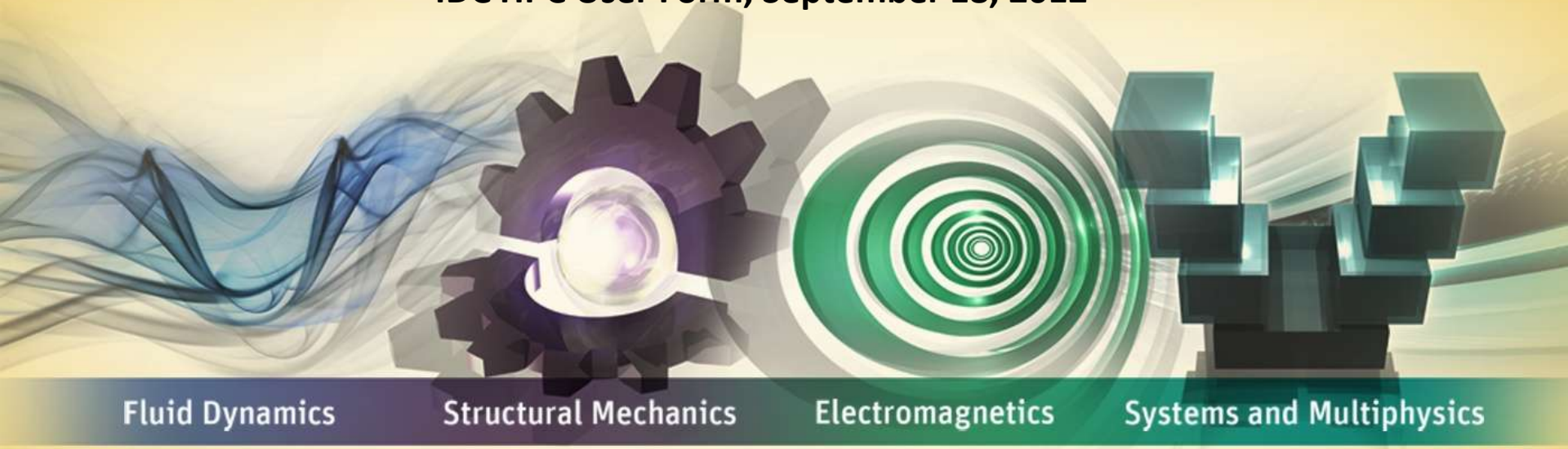
ANSYS

Realize Your Product Promise™

Industrial Value of HPC for Engineering Simulation

IDC HPC User Form, September 18, 2012



Sandeep Sovani, PhD

Manager, Automotive Strategy and Marketing

ANSYS, Inc.

ANSYS Drives:
Simulation Driven Product Development™
We enable product innovators to digitally simulate performance across all physics of complete systems and in their real-world environments.

ANSYS, Inc.

Focused
Engineering simulation is all we do.
Leading product technologies in all physics areas
Largest development team focused on simulation

Capable
2,000 employees
60 locations, 40 countries

Trusted
96 of top 100 *FORTUNE* 500 industrials
ISO 9001 and NQA-1 certified

Proven
Recognized as one of the world's most innovative and fastest-growing companies*

Independent
Long-term financial stability
CAD agnostic

**BusinessWeek, FORTUNE*

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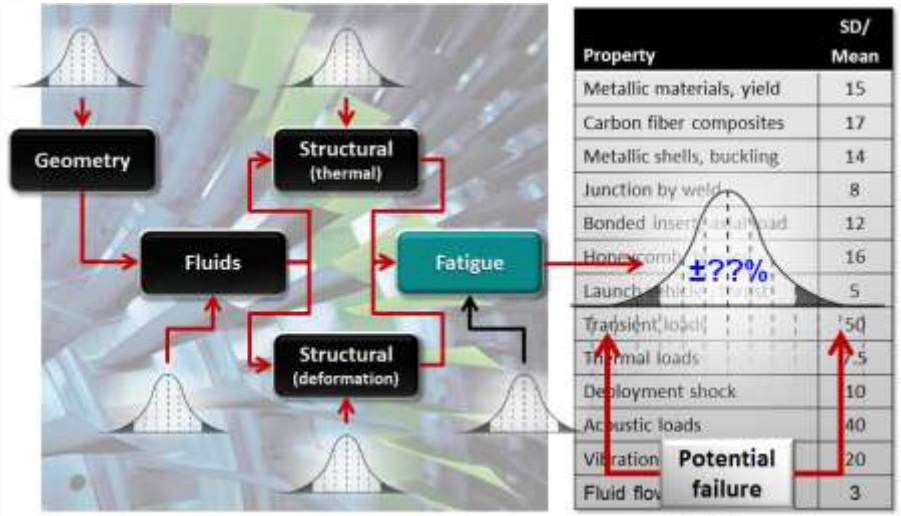
Value of HPC for Engineering Simulation

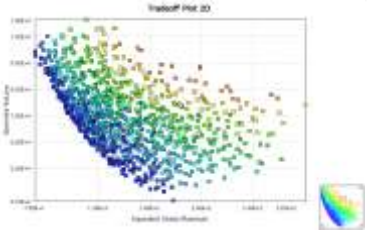
Increase product performance and integrity in less time

- Consider more design variants
- Find the 'optimal' design
- Ensure performance across a range of conditions

➢ **HPC is a key enabler to assure greater product integrity through robust design**



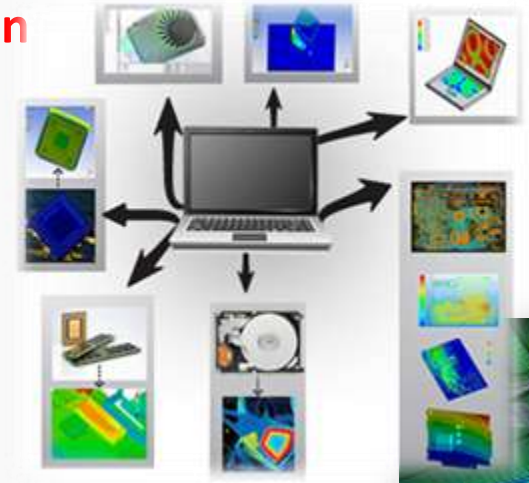
Property	SD/ Mean
Metallic materials, yield	15
Carbon fiber composites	17
Metallic shells, buckling	14
Junction by weld	8
Bonded insert pull-out load	12
Honeycomb	16
Launch shock	5
Transient loads	50
Thermal loads	7.5
Deployment shock	10
Acoustic loads	40
Vibration	20
Fluid flow	3

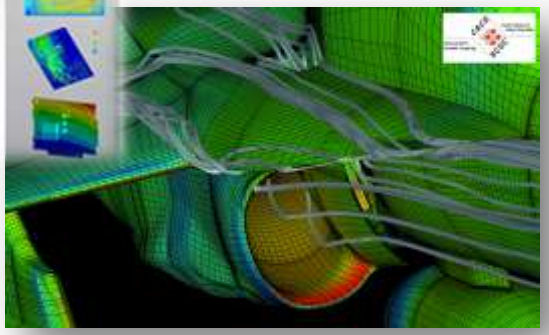


Increased product complexity!

- Assess larger, more detailed models
- Consider more complex physics
- From single component to system innovations

➢ **HPC is a key enabler to gain higher-fidelity insight**





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Case Study

Shape Optimization: “50:50:50 Study”

Challenge

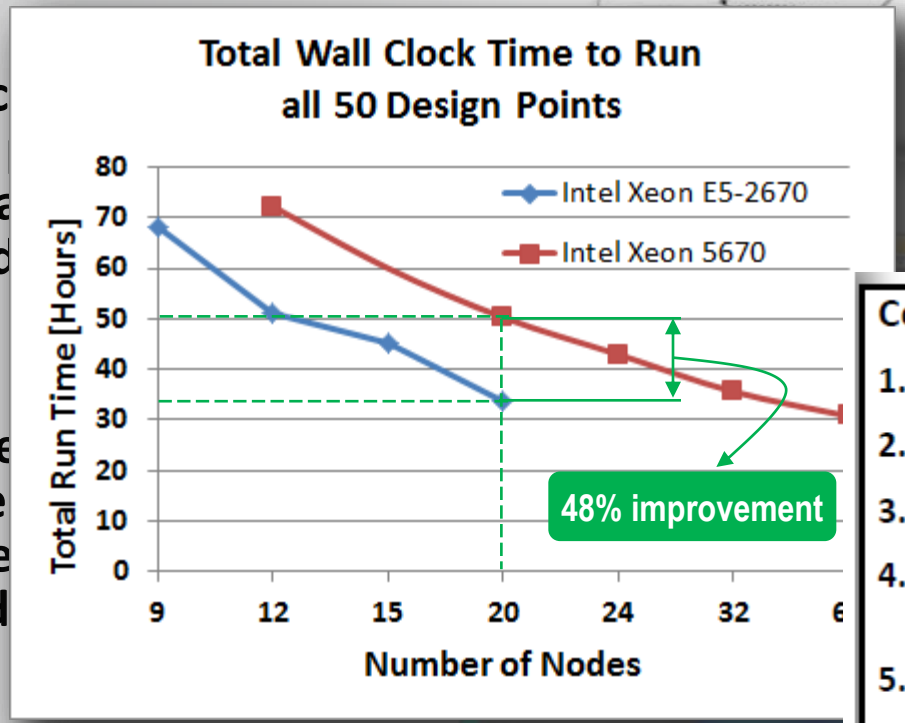
- Simulate 50 shape variants of the Volvo XC60 with high-fidelity CFD simulations using a computational mesh of 50 million cells in a total elapsed time of 50 hours (after initial case setup)

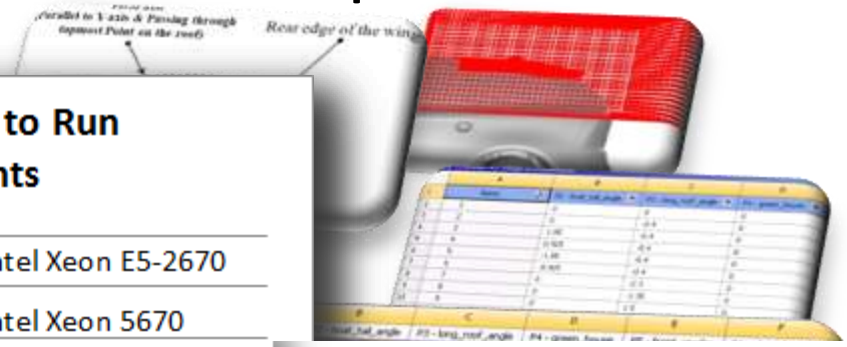
Solution

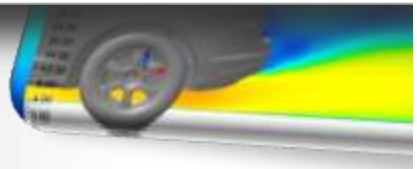
- ANSYS Workbenc
  - To drive shape
  - To create DOE a
- ANSYS Fluent and
- Intel Xeon based

Benefits

- Automatic with le
- Ability to explore
- Accurate because
- Shorten vehicle d







Compute Cluster Details

1. Intel’s Endeavor Cluster
2. Intel Xeon X5670 (dual socket)
3. Clock speed 2.93 GHz
4. Six cores per socket (12 cores per node)
5. 24 GB RAM @ 1333 MHz, SMT ON, Turbo ON
6. QDR Infiniband
7. RHEL Server Release 6.1

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Case Study

HPC for High Fidelity Turbocharger Design

- 8M to 12M element turbocharger models
- Previous practice (8 nodes)
  - Full stage compressor runs 36-48 hours
  - Turbine simulations up to 72 hours
- Current practice (160 nodes)
  - 32 nodes per simulation
  - Full stage compressor 4 hours
  - Turbine simulations 5-6 hours
  - Simultaneous consideration of 5 ideas
  - Ability to address design uncertainty – clearance tolerance

"ANSYS HPC technology is enabling Cummins to use larger models with greater geometric details and more-realistic treatment of physical phenomena."

TURBOMACHINERY

Breath of Fresh Air

Cummins uses high-performance computing to deliver better turbochargers to market — faster — by simulating the entire stage.

By John Horsley, Engineer, Air Handling, Cummins Turbo Technologies, Huddersfield, UK.

As a developer of turbochargers, Cummins Turbo Technologies has wrestled with — and now resolved — running full-stage simulation to ultimately deliver a better product. The enormous size of turbocharger simulation models, averaging 8 million elements for the compressor stage and 12 million for the turbine stage, previously made it impossible to run full-stage simulations as part of the normal design process. ANSYS computational fluid dynamics (CFD) software plays a critical role in the design process by enabling Cummins engineers to evaluate a wide range of design alternatives to optimize performance prior to building a product or even a prototype. Cummins upgraded to a 160-node high-performance compute cluster to take full advantage of the software's near-linear parallel processing capabilities. The new high-performance computing (HPC) system has reduced solution times by a factor of 12, making it possible to routinely run full-stage simulations. As a result, Cummins has been able to improve turbocharger performance and reduce time to market.

Cummins Turbo Technologies produces turbochargers for diesel engines used in automotive, off-highway, power generation and marine applications. Now a division of global power leader Cummins Inc., it was founded as Holset Engineering, producing a brand synonymous with turbo-charging and airflow management for the last five decades. Turbochargers from Cummins Turbo Technologies are found in medium- and heavy-duty diesel engines around the world.

In simple terms, a turbocharger comprises a turbine and compressor connected by a common shaft supported on a bearing system. The turbocharger compresses air flowing into the diesel engine. This enables the engine to squeeze more air into a cylinder so that more fuel can be added, which, in turn, increases the power of the engine.

In the past, Cummins designed turbochargers by going through multiple build-and-test hardware prototype cycles to verify performance, stress and fatigue life. This process was very time consuming and expensive. When the company began converting to an analysis-led design strategy, Cummins Turbo Technologies selected ANSYS CFX software as its primary CFD tool because of its industry-leading technology for turbo-machinery simulation. ANSYS CFX enables Cummins engineers to evaluate design concepts and variations virtually in a fraction of the time and cost required in the past using physical prototypes. While the data that can be captured from hard-ware prototypes is limited by sensor capabilities, CFD enables engineers to easily determine what is happening at any point in the computational domain. Simulation results show very good correlation with physical testing in the lab on the gas stand.

A typical turbocharger supplied by Cummins Turbo Technologies

"ANSYS HPC technology is enabling Cummins to use larger models with greater geometric details and more-realistic treatment of physical phenomena to generate results in less time."

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Case Study

HPC for Design Exploration

- Cognity Limited
  - Steerable conductors for oil recovery
- ANSYS Mechanical simulations to determine load carrying capacity
- 750K elements, many contacts
- 12 core workstations / 24 GB RAM
- 6X speedup / results in 1 hour or less
- 5-10 design iterations per day

"Parallel processing makes it possible to evaluate five to 10 design iterations per day, enabling Cognity to rapidly improve their design.

OFFSHORE

Deep Thinking

ANSYS structural mechanics helps save years in designing the first steerable conductor for enhanced oil recovery.

By Ian Youngs, Managing Director, Cognity Limited, Aberdeen, Scotland

One of the biggest challenges in offshore drilling is accurate placement of the conductor casing. This component is a several-hundred-meter-long tube that is pile-driven into the ground prior to drilling to prevent mud from collapsing around the hole. At offshore locations, soils tend to be relatively soft with highly variable seabed properties; these factors contribute to accurate placement, since traditional conductors follow the path of least resistance.

Engineering consulting firm Cognity Limited has addressed this problem by developing a steerable conductor that can provide real-time accurate positioning. This device must withstand compressive forces of up to 600 tons as the conductor is pounded into the ground; it also must provide an unobstructed bore once it is driven to depth. Soils increase in strength with depth, which increases the moment and loads on the conductor as it is driven into the seabed. By using ANSYS Mechanical software in the ANSYS Workbench platform, Cognity engineers doubled the load-carrying capacity of the steering mechanism, allowing the conductor to be maneuvered in very deep soils. In addition, the team finalized the design in five months, a time frame months or possibly years less than would have been required using traditional design methods.

In drilling, each conductor must be positioned accurately to help maximize field production. For example, conductors might be spaced along a 2.5 meter grid at the platform with the goal of driving them into the seabed at an angle, spreading out to cover a predefined area. Since the drilling process weakens the soil, new conductors are naturally drawn toward existing wells — which might result in abandoning the conductor if it veers too close to a live well. Poorly positioned conductors, known as "junked slots," can result in a production company incurring lost time and additional expense in sidetracking them. A worst-case scenario can occur if a conductor is placed so close to an existing well that the

Rendering of steerable conductor

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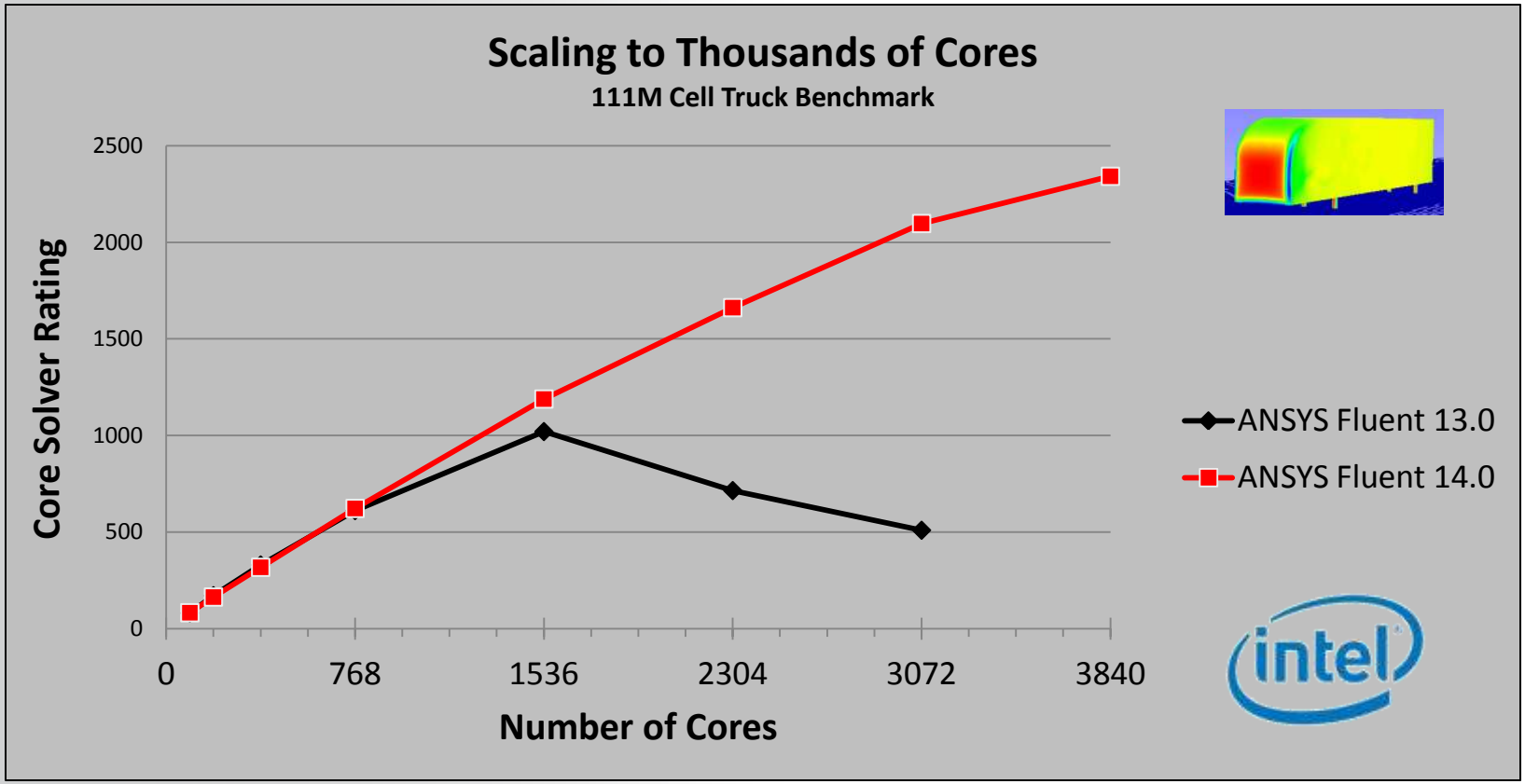
HPC is an ANSYS SW Development Priority

ANSYS is a top-tier partner with IT industry leaders, ensuring optimized HPC performance, a roadmap to the future, and wrap-around support



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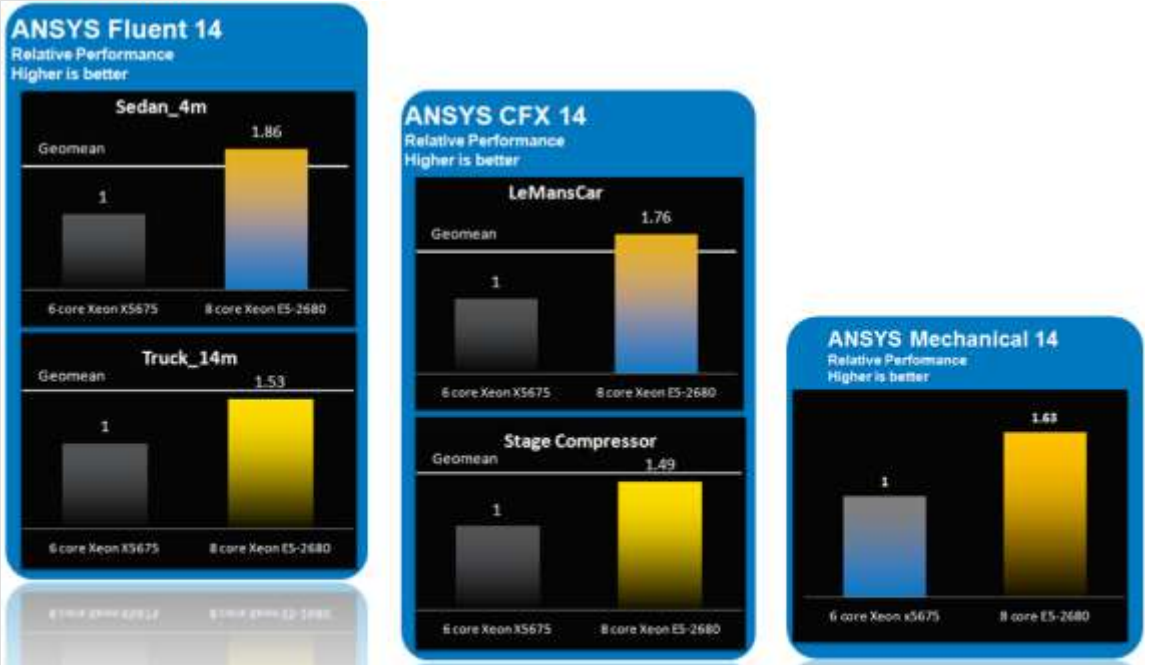
R&D Milestones

- Coding and optimization for AVX instruction set / compiler tuning
  - 40-60% speed-up on Intel® Xeon® ES-2670
- Current focus on combined Intel® Xeon® / Intel® Xeon® Phi
  - Early partnership leading to planned commercial introduction in 2013



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Summary

- Major trends in engineering are driving the need for HPC innovation
- ANSYS users realize significant gains in speed, fidelity and productivity
- ANSYS is a HPC technology leader committed to deliver optimized software performance on emerging processor technologies

Thank You

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